



STATISTICAL AND MODELING APPLICATIONS

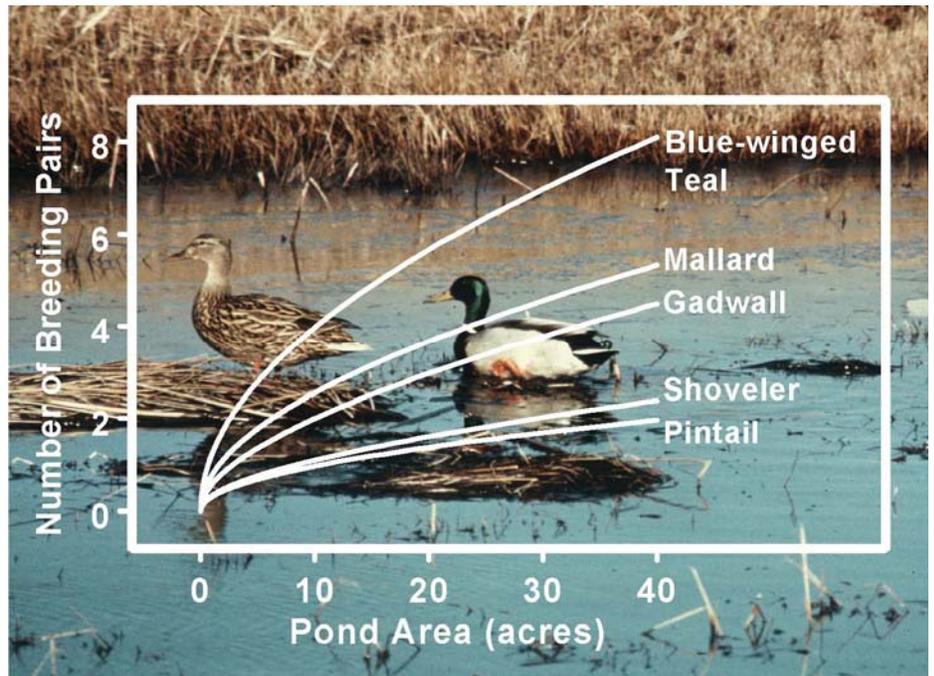
Northern Prairie Wildlife Research Center Jamestown, North Dakota

Northern Prairie Wildlife Research Center (NPWRC) develops and uses statistical methods and mathematical models in ecological research. This is reflected in the quality and scope of Center publications dealing with ecological applications of statistics and mathematics. The Center's high standard of statistical excellence have increased the quality and quantity of research products and benefited other researchers and assisted resource managers in making management decisions.

CURRENT RESEARCH

NEST SUCCESS OF BIRDS — Nest success rate is an important determinant of bird population dynamics. However, estimating nest success is not as straightforward as it seems. The most intuitive estimator—the proportion of observed nests that hatch—is often badly biased because many nests fail before they are found. NPWRC played a key role in the development of the widely-used “Mayfield” estimator of nest success, which corrects for this bias. Recently, Center statisticians developed a new analytical approach that greatly extends the capabilities of former methods, allowing for the modeling of categorical, continuous, and time-dependent explanatory variables, including random effects. These newest methods already are being used extensively and will likely revolutionize the way biologists analyze and think about nest survival data.

WATERFOWL PRODUCTIVITY MODELS — Waterfowl managers must select management strategies that provide the greatest benefit to the resource at the lowest possible cost. NPWRC has developed models and databases that predict outcomes of competing management strategies on breeding success of waterfowl, predominantly mallards and northern pintails. Currently, the Mallard Model is being adapted to incorporate brood and duckling survival rates as stochastic variables that depend on biotic and abiotic factors. These models are a popular tool of state game departments, the U.S. Fish and Wildlife Service (FWS), and non-profit organizations such as Ducks Unlimited. Software for running the models is available from NPWRC in a format compatible with Microsoft Windows XP Pro.



RESOURCE SELECTION — Animals require adequate food, shelter, and other resources to survive. Many studies seek to identify habitats that provide crucial resources by examining preferences of individual study animals. Although numerous statistical methods have been devised to address resource selection questions, NPWRC was instrumental in adapting a multivariate statistical approach that under certain criteria has optimal properties. PREFER software, developed at NPWRC for computing and estimating resource preference, is available upon request.

PREDICTING WATERFOWL NUMBERS — In the Prairie Pothole Region (PPR) of North America, the abundance of breeding waterfowl is related to numbers and types of wetlands. NPWRC has used this relationship to develop models that predict numbers of nesting ducks from landscape variables. These models are used by waterfowl managers to predict and compare breeding pair potential in various areas throughout the PPR. The models are also used by researchers to aid in study site selection and to reduce unwanted variation.

MORPHOLOGICAL CLASSIFICATION MODELS — Biologists use morphological classification models to objectively distinguish species, subspecies, and races of animals from one another. Results are especially useful for determining whether an endangered or threatened species is truly distinct and in need of special protection, and for investigating the temporal and spatial juxtaposition of races of waterfowl during migration. NPWRC has been instrumental in the development of models that are used to distinguish races of Canada geese, white-fronted geese, and sandhill cranes.

RECURRING ANIMAL SURVEYS — Biologists monitor trends in many wildlife populations by conducting annual surveys. However, resulting estimates of abundance may be less accurate than desired and cannot be readily improved because costs prohibit additional sampling. NPWRC has presented methods for using empirical Bayes estimators to combine information from each survey with prior knowledge from preceding surveys, instead of treating each survey separately, thus improving estimates of abundance.

FOUR-SQUARE-MILE BREEDING WATERFOWL SURVEY — Waterfowl managers in the PPR required a standardized breeding waterfowl survey that would provide estimates of breeding duck numbers and production by land ownership category on local areas. Working with the FWS, Northern Prairie statisticians and biologists developed a survey based on a sample of about 500 four-square-mile plots located throughout the U.S. portion of the PPR. The sample is based on statistical principles and allows for assessment of uncertainty associated with population estimates. The survey has been conducted annually since 1987 by the FWS. Center statisticians are currently working with the FWS to refine the survey methodology.

STATISTICAL ACCURACY ASSESSMENT FOR REMOTELY SENSED DATA — Most products generated from remotely sensed data are a map or image. One important question that is asked, or should be asked, is the accuracy of the map or image. Inaccuracies in maps or images need to be known prior to and accounted for in further analyses of the map itself or studies that utilize the map. Assessing map accuracy is non-trivial and usually requires a probabilistic based sampling scheme of reference or ground data which often can be complex in design. Accuracy assessments therefore need to account for the actual statistical design used to ascertain map or image accuracy. NPWRC statisticians have developed and adapted design-based methods and written software for assessing map accuracies generated from thematic images for North Dakota GAP landcover estimates.

RELATED ACTIVITIES

STUDY PLAN DEVELOPMENT — Statisticians work closely with NPWRC biologists to help assure the quality and productivity of every proposed study. Assistance includes formulating research questions as statistical hypotheses, devising sampling methods and an experimental design, estimating required sample sizes, and proposing tentative plans for the analysis of resulting data. Each proposed study is also subjected to peer review by a four-member research advisory committee, which includes a NPWRC statistician.

DATA ANALYSIS AND MODELING — Most data collected by NPWRC staff are analyzed by staff statisticians. This collaborative arrangement has proven highly productive. Ecological data frequently require non-standard or complex analyses that are beyond the training of most biologists. By working with NPWRC statisticians, investigators are able to devote most of their time to biological issues, yet make efficient use of a broad array of specialized statistical methods and software. Insights gained through interactions of statisticians and biologists have resulted in numerous contributions to the statistical and ecological literature.

MANUSCRIPT PREPARATION AND REVIEW — Manuscripts carrying a NPWRC byline are subjected to an in-house statistical review, with special attention to the appropriateness of methods and the clarity of methods and results. Methods and results of many NPWRC manuscripts are written or rewritten by a Center statistician. This policy assures the quality of manuscripts and is partly responsible for the high 100% initial acceptance rate of NPWRC manuscripts for publication.

INTERAGENCY CONSULTING — NPWRC statisticians consult with researchers and natural resource managers from partner agencies within the Department of the Interior, other federal and state agencies, universities, and private conservation organizations. Assistance on research of mutual interest ranges from study planning to data analysis and interpretation. Examples of recent consultations include assistance to the FWS on waterfowl pair-wetland regressions; analysis of carnivore survey data for the Minnesota Department of Natural Resources; evaluation of furbearer harvest surveys conducted by the Kansas Department of Fish, Wildlife and Parks; and analysis of songbird nest survival data from J. Clark Salyer NWR.

FOR FURTHER INFORMATION:

Wesley E. Newton
Northern Prairie Wildlife Research Center
8711 37th Street SE
Jamestown, North Dakota 58401-7317
(701) 253-5523
wesley_newton@usgs.gov

Terry L. Shaffer
Northern Prairie Wildlife Research Center
8711 37th Street SE
Jamestown, North Dakota 58401-7317
(701) 253-5522
terry_shaffer@usgs.gov